

NHTSA Evaluation of the Hybrid III 10 Year Old Dummy

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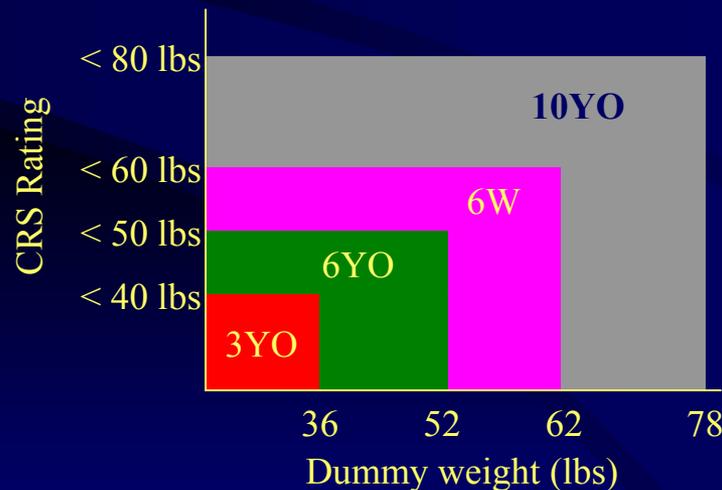
SAE Government/Industry Meeting 2003

Overview

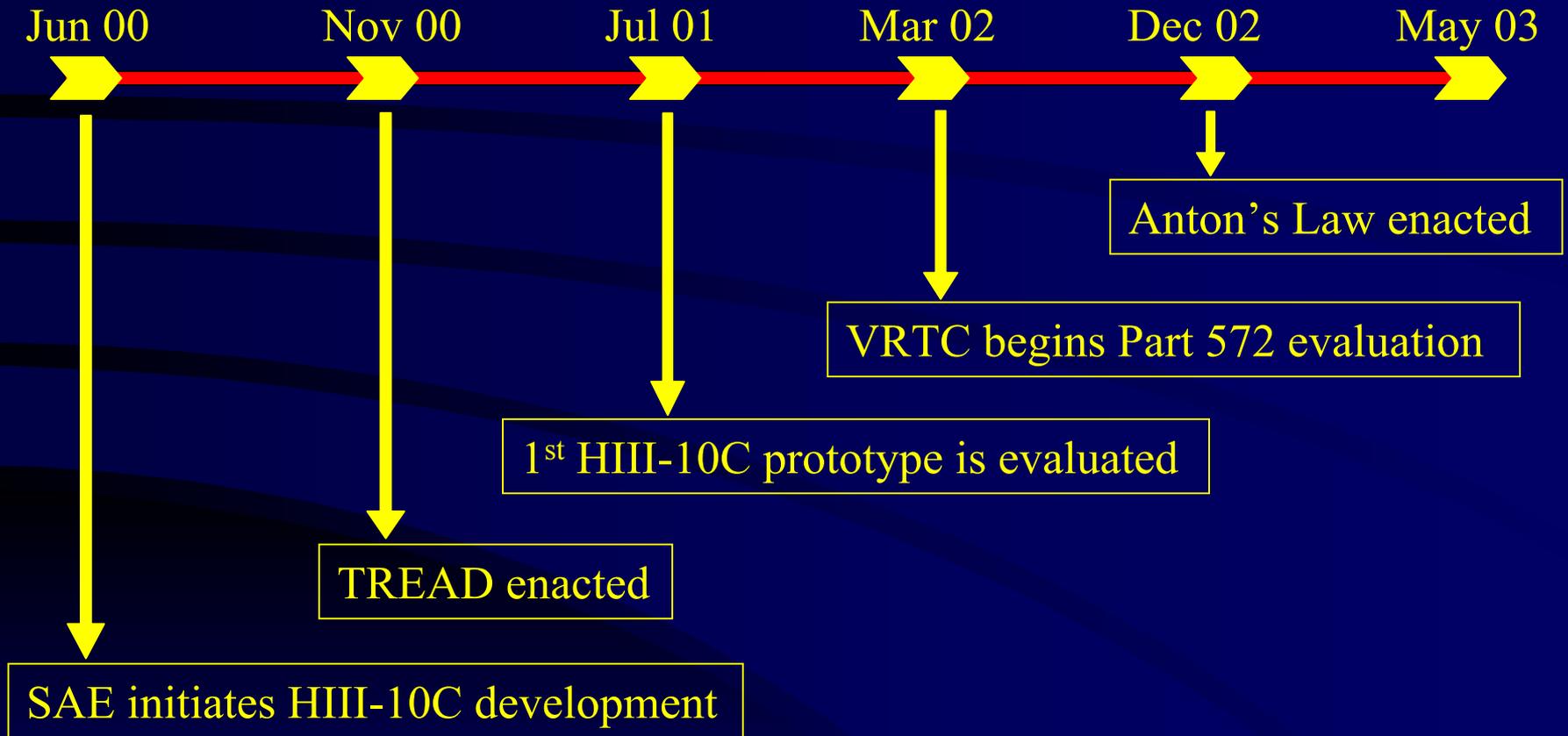
- Why a “10 year old” dummy?
- History/background
- NHTSA role in HIII-10C development
- HIII-10C dummy features
- VRTC evaluation program
- Future work

Why a “10 Year Old”?

- NHTSA, advocates pushing booster use
- Boosters made to protect kids up to 80 lbs
 - Meet state requirements for use
 - No dummy to test these larger CRS

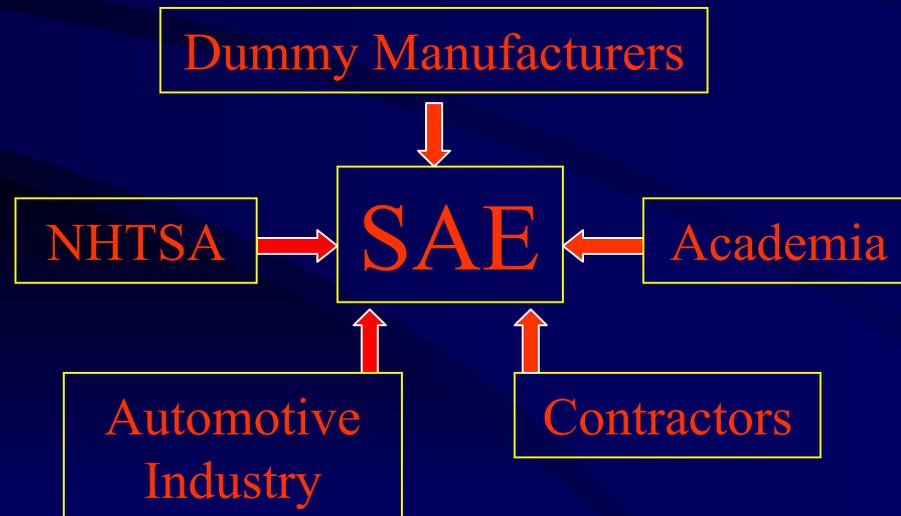


Background



NHTSA's Role

- Attended/participated in SAE meetings
- Evaluated 1st prototype dummy
- Evaluating “production-intent” dummies



Dummy Description



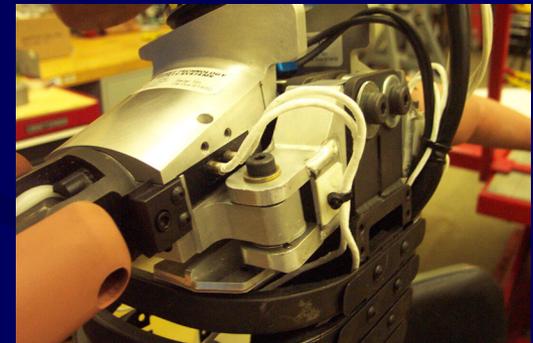
Weight = 77.6 lbs (35.3 kg)

Sitting Height = 28.5 in (72.4 cm)

Theoretical Standing Height = 51 in (129.5 cm)

FEATURES:

Instrumented
shoulders with
more realistic
shape



Dummy Description



Weight = 77.6 lbs (35.3 kg)

Sitting Height = 28.5 in (72.4 cm)

Theoretical Standing Height = 51 in (129.5 cm)

FEATURES:

Thoracic
instrumentation
optional to chest
ball-slider
mechanism



Dummy Description



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Sitting Height = 28.5 in (72.4 cm)

Theoretical Standing Height = 51 in (129.5 cm)

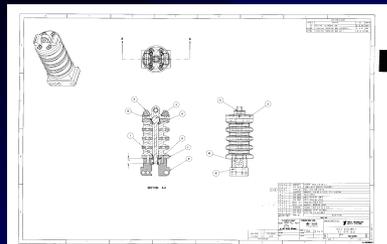
FEATURES:

Adjustable
lumbar angle to
simulate slouch
posture in
children



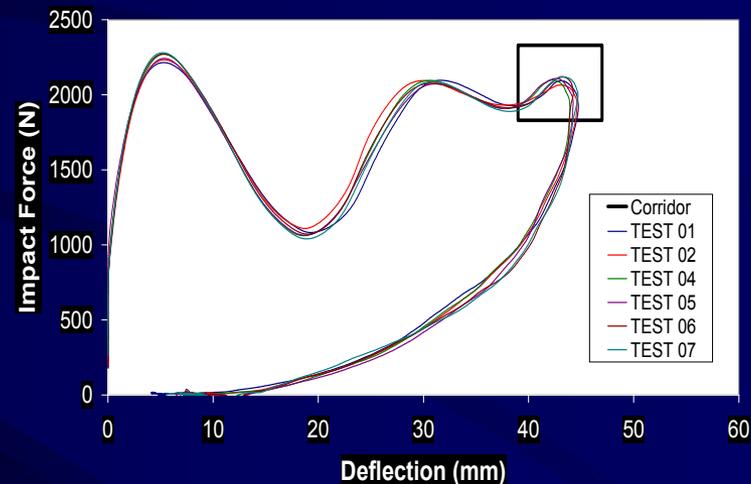
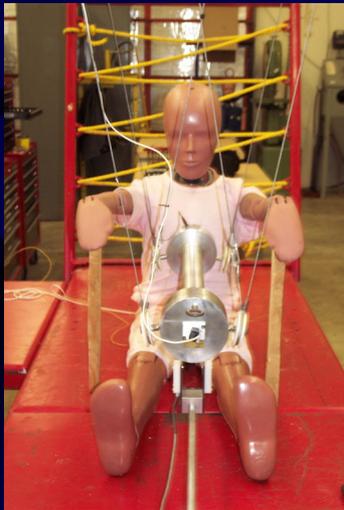
Inspection

- Received drawings from each manufacturer
 - Reviewed them for completeness, accuracy
- Acquired two dummies
 - Conducted part-by-part inspection vs. drawings
- Reviewed external dimensions & weights



Component Testing

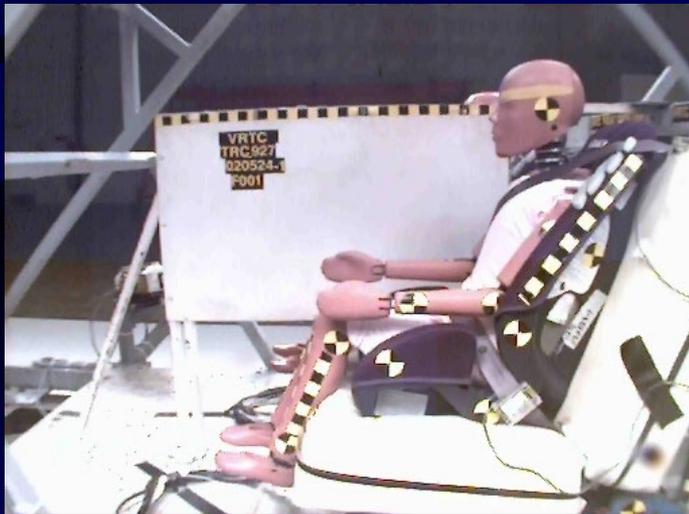
- Tested head, neck, thorax, knees, torso flex
 - SAE-proposed test procedure and response corridors (Mertz et al, 2001 Stapp)



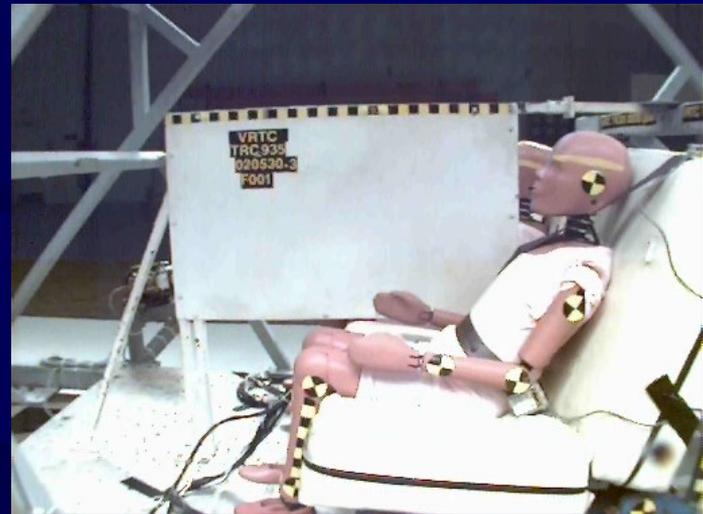
➡ Components within corridor, repeatable

Booster Seat Testing

- Two dummies per test
- Five seating configurations
 - Two boosters, three non-booster (upright, slouched, belt misuse)



Booster



No Booster (Slouched)

Booster Seat Testing

| | Boosters | Non-Booster (Upright) | Non-Booster (Slouch) |
|-----------------------------------|----------------|--------------------------|-------------------------|
| HIC Unlimited | 653 | 965 | 1306 |
| Neck Occipital Moment (Nm) | 40 (F) | 49 (E) | 45 (E) |
| Lower Neck Y Moment (Nm) | 256 (F) | 375 (F) | 308 (F) |
| Chest Deflection (mm) | 39 | 37 | 36 |
| Chest Acceleration (g) | 50 | 54 | 52 |
| Lumbar Shear Force (N) | 1999 | 3743 | 4917 |

** (F) = Flexion (E) = Extension



Boosters make a difference



Minor durability problems solved

Vehicle Sled Testing

- 2000 Model Year Large SUV
- NCAP-derived crash pulse (25 g, 35 mph)
- Booster and non-booster situations



Booster



No Booster (Upright)



No Booster (Slouch)

Vehicle Sled Testing

| | Boosters | Non-Booster (Upright) | Non-Booster (Slouch) |
|-------------------------------------|-------------|--------------------------|-------------------------|
| HIC Unlimited | 1188 | 1332 | 1450 |
| Neck Occipital Moment (Nm) | 44 (F) | 50 (F) | 39 (F) |
| Upper Neck Tensile Force (N) | 3087 | 3898 | 4648 |
| Chest Deflection (mm) | 42 | 36 | 33 |
| Chest Acceleration (g) | 55 | 57 | 53 |
| Lumbar Shear Force (N) | 1462 | 2083 | 5494 |

 “Submarining” = high lumbar forces

 Some rib delamination present

Static OOP Airbag Testing

- Durability of neck structure/instrumentation
 - Setup in head and chest-to-IP
- Utility of IR-Tracc system



Static OOP Airbag Testing

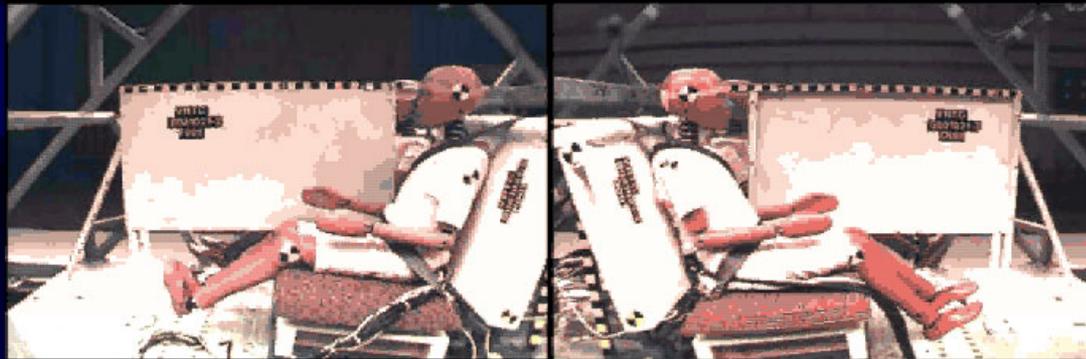


| | |
|------------------------------|---------|
| Upper Neck Tensile Force (N) | 4544 |
| Upper Neck X Shear Force (N) | 2395 |
| Neck Occipital Moment (Nm) | 170 (E) |
| Lower Neck Tensile Force (N) | 4259 |
| Chest Deflection (mm) | 23 |
| Chest Acceleration (g) | 70 |

- ➔ Neck load cells have sufficient capacity
- ➔ Neck components durable
- ➔ IR-Tracc displayed no problems

Two-Dummy R&R Testing

- Assess repeatability and reproducibility
- Rigid 213 seat, 75% energy pulse, 5 tests
 - Minimize non-dummy variation



Two-Dummy R&R Testing

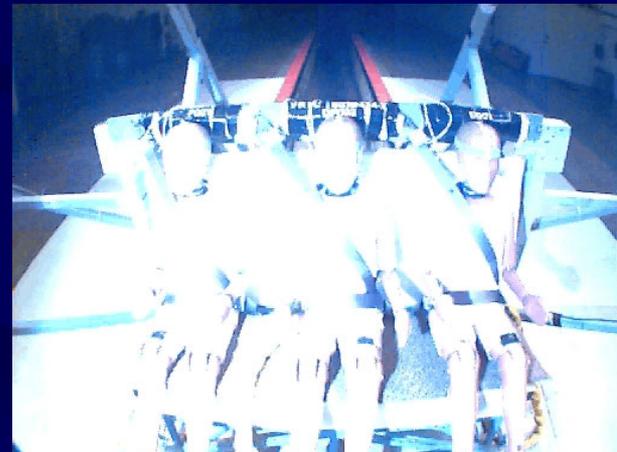
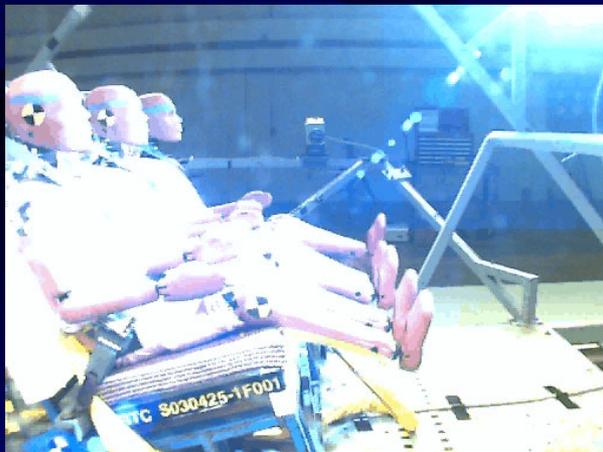
| | Dummy #1 | | Dummy #2 | |
|----------------------------|----------|------|----------|------|
| | AVG | CV | AVG | CV |
| HIC Unlimited | 456 | 6.0% | 431 | 3.9% |
| Neck Occipital Moment (Nm) | 34.3 | 6.6% | 34.8 | 3.6% |
| Lower Neck Y Moment (Nm) | 186 | 7.9% | 170 | 2.4% |
| Chest Deflection (mm) | 31 | 5.4% | 26 | 5.4% |
| Chest Acceleration (g) | 41 | 4.4% | 39 | 1.6% |
| Lumbar Shear Force (N) | 1225 | 9.7% | 1168 | 5.0% |

 Repeatability (88% of channels < 10% CV)

 Reproducibility (59% of channels < 10% CV)

Three-Dummy R&R Testing

- Assess reproducibility
 - One full dummy from each manufacturer, one with half (upper and lower torso) built by each manufacturer
- Rigid 213 seat, FMVSS 213 pulse, 4 tests



Three-Dummy R&R Testing

| | AVG | CV |
|------------------------------|------|-------|
| HIC Unlimited | 539 | 7.6% |
| Neck Occipital Moment (Nm) | 37.6 | 10.0% |
| Upper Neck Tensile Force (N) | 1797 | 6.1% |
| Chest Deflection (mm) | 32 | 6.6% |
| Chest Acceleration (g) | 39 | 5.8% |
| Lumbar Y Moment (Nm) | 83 | 5.6% |
| Pelvis Acceleration (g) | 45 | 7.7% |

 Good reproducibility

 Dummy parts are interchangeable

Summary

- Three HIII-10C conformed to drawings
- Components meet SAE corridors
- Boosters reduce head, neck, lumbar loads
- Durable in severe airbag/sled environments
- Good repeatability and reproducibility
- Mixing parts doesn't affect performance

Remaining Work

- Put dummy in a crash test environment
- Evaluate IR-Tracc more thoroughly
- Develop injury criteria

THANK YOU!!!